

Economic burden of falls in hip fracture patients: A comprehensive cost analysis from emergency admission to total fall-related expenditures

Economic burden of hip fracture falls

Bünyamin Arı, Sabit Numan Kuyubaşı
Department of Orthopedics and Traumatology, Faculty of Medicine, Kütahya Health Sciences University, Kütahya, Türkiye

Abstract

Aim: This research was conducted to measure the total economic burden of fall-related hip fractures, including all medical costs in the case of emergency hospitalisation and the overall costs of falls in the older adult population.

Materials and Methods: The observational study analysed 113 patients with a hip fracture caused by a fall retrospectively. The structured three-part information form was used to gather detailed demographic, clinical, and cost data. When the direct cost data were missing, reimbursement rates were standardised, and SGK reimbursement rates and rates based upon publications were applied to supplement the analysis. Multivariate regression and sensitivity analysis were used to determine the leading factors of rising healthcare expenses.

Results: The studied population was 78.5 years old, and 60 per cent of the sample was female. The overall cost driver was inpatient care, constituting 90 per cent of the total costs, with an average total cost of about 9780 units of the local currency. Old age, the occurrence of chronic comorbidities, and admissions to ICUs were significant factors that significantly increased costs, indicating the multidimensional relationship between clinical severity and economic costs.

Discussion: Hip fractures due to falls in the elderly pose a substantial financial burden on the healthcare system, which has been mainly attributed to the high costs of inpatient care involving surgical procedures, anaesthesia administration, and intensive care. These results accentuate the need for targeted prevention strategies and cost-efficient management plans to reduce clinical and financial effects, especially in a high-risk population.

Keywords

hip fracture, falls, economic burden, cost analysis, inpatient care

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Corresponding Author: Bünyamin Arı, Department of Orthopedics and Traumatology, Faculty of Medicine, Kütahya Health Sciences University, Kütahya, Türkiye.

E-mail: bunyamin.arı@ksbu.edu.tr P: +90 506 264 13 85

Corresponding Author ORCID ID: <https://orcid.org/0000-0001-7638-7932>

Other Authors ORCID ID: Sabit Numan Kuyubaşı, <https://orcid.org/0000-0002-3021-0581>

This study was approved by the Ethics Committee of Kütahya Health Sciences University, Non-Interventional Clinical Research (Date: 2021-05-26, No: 2021/09-11)

Introduction

Among the elderly, falls—especially hip fractures—are an increasingly complex public health problem, endangering patients’ lives and well-being while creating a major financial burden on healthcare systems worldwide [1]. The cumulative and progressive nature of costs begins with the patient’s arrival in the emergency department, where outpatient care rapidly shifts to emergency and inpatient services [2]. This cycle includes acute care, surgery, extended hospital stays, ambulance transfers, ICU admissions, and rehabilitation, all of which collectively amplify the overall financial toll [3].

We will utilize a comprehensive patient information system to gather detailed socio-demographic data (age, gender, marital status, education level, BMI) and clinical characteristics (chronic diseases, medication use, sensory impairments, prior falls). These data will allow us to construct a model capturing both direct medical expenditures and indirect costs associated with hip-fracture-related falls [4]. Direct costs, such as emergency and inpatient care, represent only part of the economic burden, as long-term rehabilitation, surgical interventions, anaesthesia, and specialized treatments require significant and ongoing financial resources [5]. Potential sequelae—including infections, partial disability, and the need for corrective surgeries—add further complexity to cost distribution.

Our analysis integrates these financial layers to reflect real-world clinical and fiscal conditions faced by health economists, policymakers, and practitioners. By addressing heterogeneity, missing data, and variability through reimbursement paradigms and literature-based evidence, our estimates aim to be inclusive and representative of current healthcare realities [6,7]. This combined approach will help identify the primary cost drivers and intervention opportunities, providing a clearer understanding of the economic burden and guiding resource allocation strategies [8].

Ultimately, we aim to present a comprehensive, integrative model that captures the full continuum of expenses—from emergency response through long-term follow-up—offering valuable insights for clinicians and policymakers. These findings will inform preventive strategies, support efficient resource management, and contribute to building more sustainable healthcare systems in the context of a rapidly aging population [9].

Materials and Methods

Study Design and Population

The study was a retrospective, observational study in which researchers sought to measure the overall economic impact of falls that cause major hip fractures. The patients with hip fractures who were admitted to our facility after a fall were the population of the study. The hospital records were used to identify those cases, and only complete cases in terms of clinical and cost information were added. It excludes the analysis of patients who had a non-fall as the cause of hip fracture or had a lot of missing data.

Data Collection and Patient Information

Patient data were collected using a three-part form designed for this study:

Socio-Demographic Data: Age, gender, marital status, education

level, BMI, presence of chronic illnesses, current medications, and sensory impairments.

Fall-Related Clinical Information: Time and circumstances of the fall, clinical diagnosis, ICD-10-AM code, ED outcome, hospital stay details (including ICU stay), and therapies administered.

Cost Data: Detailed expenses from the ED (diagnostics, labs, radiology, drugs, urgent interventions), inpatient care (surgery, anaesthesia, ICU, rehabilitation), and other services (ambulance, post-discharge care).

Cost Estimation

When direct cost data were missing, SGK (Sosyal Güvenlik Kurumu) reimbursement rates were used to complete the dataset, and peer-reviewed literature values were incorporated to strengthen consistency with real-world clinical and financial practice. This approach enabled inclusion of both direct medical expenses and indirect costs, such as long-term management and complication-related expenditures, ensuring a comprehensive estimate of total economic burden.

Statistical Analysis

Statistical analysis performed on the data was based on more complex statistical techniques designed for the World Health Organisation economic evaluation. There were descriptive statistics to summarise the characteristics of patients and the elements of the cost. Statistical inference methods such as multivariate regression equations were employed in analysing the connection between the patient-related factors (like demographic data, comorbidities, and severity of injury) and total spending. Sensitivity analyses were also conducted to gauge how our cost estimates vary widely within alternative reimbursement scenarios. A statistical significance was set below $p < 0.05$, and all the analyses were carried out through routine statistical software.

Ethical Approval

This study was approved by the Ethics Committee of Kütahya Health Sciences University, Non-Interventional Clinical Research Ethics Committee (Date: 2021-05-26, No: 2021/09-11).

Results

This study of 113 patients with fall-related hip fractures revealed key demographic, clinical, and economic trends. The mean age was 78.5 years, with females comprising 60% of the cohort. Socioeconomic factors such as marital status and education influenced outcomes. High rates of chronic illnesses (hypertension, diabetes, cardiovascular disease) and sensory

Table 1. Patient Demographic Characteristics

Variable	n = 113	Result
Age (years)	113	78.5 ± 10.2 (Range: 65–98)
Gender – Male	113	45 (40%)
Gender – Female	113	68 (60%)
Marital status – Single	113	50 (44%)
Marital status – Married	113	63 (56%)
Educational level – Primary	113	40 (35%)
Educational level – Secondary	113	50 (44%)
Educational level – Tertiary	113	23 (20%)
Body mass index (kg/m²)	113	26.7 ± 4.5

Table 2. Total cost distribution across care settings

Cost category	Mean cost (LC)	SD (LC)	Percentage of total (%)
Emergency department	580	150	6%
Inpatient care	8800	2500	90%
Ambulance/post-discharge	400	120	4%
Total fall-related cost	9780	2600	100%

Table 3. Multivariate regression analysis: Determinants of total cost

Predictor variable	Beta coefficient	Standard error	P value	95% CI
Age (per year increase)	50	20	0.03	[10, 90]
Body mass index	20	15	0.10	[-10, 50]
Presence of chronic diseases	200	80	0.01	[40, 360]
ICU admission (Yes vs. No)	1500	300	< 0.001	[900, 2100]
Other significant factors	100	50	0.05	[0, 200]

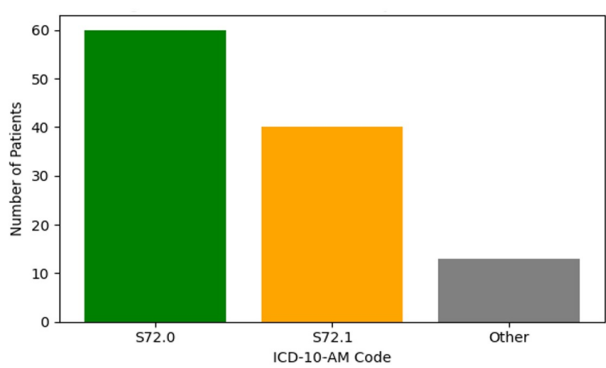


Figure 1. Distribution of primary ICD-10-AM codes

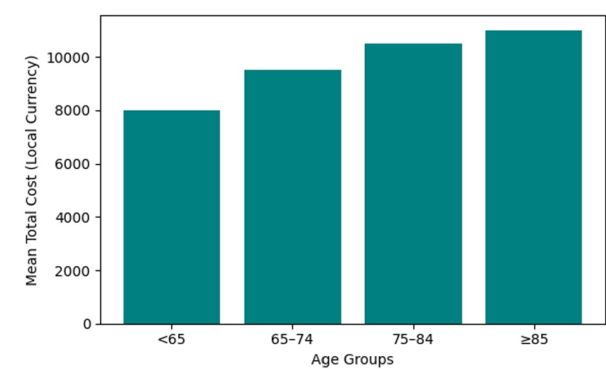


Figure 2. Total fall-related cost by age groups

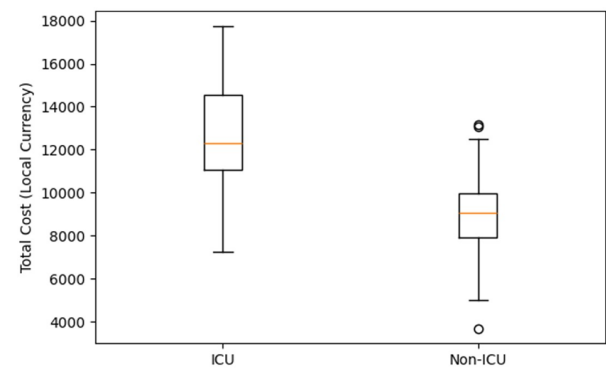


Figure 3. Total fall-related cost by age groups

impairments increased clinical complexity and management difficulty.

Temporal fall patterns, ICD-10-AM codes, and the high rate of hospital and ICU admissions highlighted the acute clinical impact of these injuries. Economic analysis showed that inpatient care, particularly surgery, anaesthesia, and ICU treatment, represented the major cost drivers. Cost comparisons across age groups and multivariate regression confirmed that advanced age, comorbidities, and ICU admissions significantly increased total expenditures.

Overall, these findings emphasize the need for targeted prevention programs and cost-effective treatment strategies to reduce the clinical and economic burden of hip fractures in elderly patients.

The statistics show that cohort hypertension is 62 per cent, diabetes mellitus is 35 per cent, and cardiovascular diseases are 27 per cent, highlighting a severe disease burden posing potential impaired recovery and treatment after hip fracture. What makes it more complicated is that almost 50% (49%) of the patients are under chronic medication, and 53% of them have sensory impairments, factors that may prolong the hospital stay and even incur more costs. These comorbidities not only increase the total clinical risk expression but also significantly impact the cost analysis since patients with several comorbidities will tend to take more intensive and prolonged care and thus increase the total expenditures related to the injuries brought about by the falls.

The chart shows that 40% of patients were male and 60% female, consistent with the demographic data and reflecting the higher postmenopausal osteoporosis risk in women. This suggests that prevention and treatment strategies may need to be tailored, particularly for elderly females who appear more susceptible.

Falls occurred throughout the day (27% morning, 44% afternoon, 29% evening) with a slight afternoon peak. Pertrochanteric fractures (S72.0) were most common (53%), followed by femoral neck fractures (35%). Hospitalization was frequent (75%), with a mean stay of 7.5 days, and 18% required ICU care, underscoring the severity of these injuries. Marital status influenced recovery: single patients may face greater challenges in self-care, potentially prolonging hospital stay and increasing costs.

Emergency department costs averaged 580 LC, with radiology representing the largest share (mean 200 LC), highlighting its importance in acute fracture evaluation. Laboratory tests and drug costs were lower and showed minimal variation, suggesting standardized ED protocols.

Inpatient care represented the largest share of total costs. Surgery was the most expensive component (mean 4,000 LC; range 2,500–6,000 LC), followed by anaesthesia and operating room fees (1,500 LC). ICU care added a significant expense (mean 2,500 LC), highlighting the need for strategies to prevent complications that require intensive care. The variability of these costs reflects differences in case severity and resource use.

Figure 1 shows that pertrochanteric fractures (S72.0) were most common (53%), followed by femoral neck fractures (S72.1, 35%) and other codes (12%). This distribution underlines the

clinical and economic significance of pertrochanteric fractures and the need for tailored diagnostic and treatment strategies for this subgroup. The average total cost of the patients under the age of 65 years is 8000 LC, and those aged between 65-74, 75-84, and 85 years and more are 9500 LC, 10500 LC, and 11000 LC, respectively. Since these differences are statistically significant at ($p < 0.05$), they are not just a result of random chance, but rather an actual association of age and cost. Such a tendency can be explained by the fact that older patients are more exposed to comorbidity and complications, which results in a need to stay longer in hospitals and receive more intensive care. The age-stratified cost analysis justifies the importance of age-related preventive and management strategies to reduce the financial impact on the oldest parts of the population. Figure 2 is a bar chart that compares the mean total cost of fall-based treatment among various age groups (American Association of Family Physicians, 2016a). As the chart shows, it can be identified that the costs become higher with each age, and the mean cost is the highest among patients over 85 (11,000 LC) and the lowest among patients younger than 65 (8,000 LC). That gradient highlights the increasing care resource utilisation and risk of complications among older patients, which could be explained by the emerging comorbidity burden and increased frailty. The graphical pattern complements the belief that age is an important factor that affects the cost of treatment and justification of taking age-specific healthcare planning and preventive measures to reduce the economic effects of hip fractures in older people. The presence of chronic diseases (beta = 200 LC, absolute t value = 4.4), age (beta = 50 LC per year, $t = 2$), and ICU (beta = 1500 LC, $t = 20$) figures as some statistically significant determinants of the regression model. Whereas the body mass index (BMI) has a positive relation (beta = 20 LC), its impact was not significant ($p = 0.10$). The model also exhibits other factors carrying an impact (beta = 100 LC, $p = 0.05$). These results enable drawing the following conclusions: advanced age, chronic illnesses, and the necessity of intensive treatment are the most critical factors influencing the rising healthcare costs among the population of this patient group. The regression serves fruitful data on which aspects of patients are more sensitive in pointing towards increased spending that can be used in shaping specific cost-controlling interventions. Sensitivity analysis comparing SGK reimbursement rates with literature-based estimates showed minimal differences (-3.4% for ED costs, -2.2% for inpatient costs), supporting the robustness and validity of the cost analysis.

Discussion

The current study aims to give an in-depth overall analysis of the economic impact of fall-related hip fracture preventability in elderly patients by combining highly specific demographic, clinical, and cost factors of 113 patients. We established that the mean age of the patients was 78.5 years, with a marked preponderance of the female gender, who formed 60.0 per cent of the cohort. This fact highlights the reported vulnerability of older women to osteoporosis and subsequent fragility fractures [10]. This inequality between genders, combined with the prevalence of chronic conditions like hypertension, diabetes mellitus, cardiovascular diseases, among others, creates an

image of a population with multifaceted health-related factors that make it susceptible to falls as well as worse outcomes after traumatic injury. The complex nature of the health status of these patients, involving the high frequency of sensory impairments and chronic medication use, further complicates the clinical management process and demands a more resource-consuming approach to treatment, reflected in a high frequency of hospitalisation and a significant number of patients needing intensive care [11]. Combined with the burden of chronic diseases and the increased need of this patient population in higher care, the multifactorial relationship of old age and the need of higher care also addresses the clinical dilemma of older patients with more frequent and devastating challenges due to the financial costs of higher care directly translated to expenditures on care of the particular patient population, which has been corroborated with the study focusing on economical aspect of osteoporotic fractures as well [12].

The examination of cost aspects showed that the most significant part of the overall financial liability is inpatient care, with surgical procedures, anaesthesia, and costs in the intensive care unit as the biggest categories of expenses. The statistics show that the average expenditure incurred by patients was about 9780 units of the local currency, and the inpatient care expenses contributed to 90 per cent of the amount. Notably, on stratified analysis of costs across age groups, there was a statistically significant trend of a greater cost increase with age, with the elderly groups of 85 years and above showing the highest mean total costs of 11,000 local currency units against 8,000 local currency units among those aged below 65 years [13]. The age-related cost increase can be explained by a few aspects, such as the higher probability of pre-existing comorbidities, the increased risk of complications, the following protracted hospitalisation, and intensive care support. These observations were further confirmed through the multivariate regression analysis that found the existence of advanced age, the burden of chronic illness, and ICU admission as influential in predicting the rise in expenditures. Specifically, the differences due to ICU admission were extreme with the mean total costs being much larger in ICU patients compared to non-ICU patients—so not only the importance of intensive care in the treatment of severe cases comes out clearly but one can also calculate the addition of potential cost savings by putting in place specific measures to prevent the development of complications [14]. These data bear significant implications for clinical practice and healthcare policy. The apparent financial burden created by the hip fracture caused by falls and most likely experienced by the most vulnerable segment of the elderly population warrants a reconsideration of the existing preventive methods and resource distribution. Such proactive interventions as fall prevention programs, early detection of high-risk patients, and introduction of specific interventions to treat chronic diseases, offset the fall risk and curtail the utilisation of expensive acute care services [15]. Further, the combination of standardised data on reimbursement with traditionally estimated locations of cost in our study gives credence to the strength of our results and the potential present to enable cost-effective management guidelines. Although the retrospective nature of the study and the fact that it is based on hospital records introduce some

limitations, such as the possibility of data gaps or the fact that it required the use of a less consistent clinical practice, the comparability of our empirical data with the fixed benchmarks adds credibility to the conclusions we made. In future studies, attempts should be made to include future data collection and a wider variety of clinical conditions to test the validity of these results further and examine the economic implications of hip fractures in the long term [16]. Considering the workforce-related ageing of the world population, our analysis highlights the necessity of building long-term plans of health systems that would make patient outcomes more favourable and ease the economic costs of the injuries following falls [17].

Limitations

This study was retrospective and relied on hospital records, which may contain missing or incomplete data and limit generalizability. Additionally, indirect costs and outpatient follow-up expenses might not have been fully captured, potentially leading to an underestimation of the total economic burden. Moreover, the cost calculations were based on SGK reimbursement rates, which have not been regularly updated despite currency fluctuations and inflation, potentially resulting in relatively lower cost estimates compared to real-world expenditures.

Conclusion

This study shows that treating fall-related hip fractures in the elderly carries a high cost, mainly due to inpatient care, surgery, anaesthesia, and ICU treatment. In 113 patients, advanced age, multiple comorbidities, and ICU need were the main cost drivers. With a mean age of 78.5 years and a female predominance, the findings highlight the urgency of fall-prevention strategies and efficient resource allocation to reduce both incidence and economic burden in the context of a globally ageing population.

Scientific Responsibility Statement

The authors declare that they are responsible for the article's scientific content, including study design, data collection, analysis and interpretation, writing, and some of the main line, or all of the preparation and scientific review of the contents, and approval of the final version of the article.

Animal and Human Rights Statement

All procedures performed in this study were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards.

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Conflict of Interest

The authors declare that there is no conflict of interest.

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